FILE COPY [redacted] ORNL

MASTER COPY

#348

X-426 (Revised 1-52)

OAK RIDGE NATIONAL LABORATORY

Operated By

CARBIDE AND CARBON CHEMICALS COMPANY

UCC

POST OFFICE BOX P

OAK RIDGE, TENNESSEE

ORNL

CENTRAL FILES NUMBER

54-7-108

DATE: July 14, 1954

SUBJECT: METAL RECOVERY: Hanford Metallurgical Waste: Operational Summary for Period March through May 1954

TO: F. L. Culler

FROM: R. E. Brooksbank

This document consists of 22 pages.
Copy 14 of 14 copies. Series A

DISTRIBUTION:

1. F. L. Culler
2. R. E. Brooksbank
3. F. R. Bruce
4. W. K. Eister
5. H. E. Goeller
6. H. K. Jackson
7. C. E. Lamb
8. R. B. Lindauer
9. W. H. Lewis
10. J. L. Matherne
11. E. M. Shank

12-13. Lab. Records Dept.

14. ORNL-RC

DECLASSIFIED

by authority of:

Multiple Sources

(Authorized Declassifier's name and organization)

or M. R. Theisen, ORO Classif. Officer

(Official declass notice, memo, TIC notice, etc)

Arvin S. Quist 12/11/92

(Person making change) (date)

Classif. Officer, ORNL

[redacted]ATA

Thi[redacted]ent contains Restricted Data as [redacted] the Atomic Energy Act of 1946. Its [redacted] the disclosure of its con[redacted]ner to an unauthorized person [redacted]bited.

S[redacted]ER SHEET

CONTENTS

1.0 INTRODUCTION

Operation of the ORNL Metal Recovery Plant is reported in a series of monthly progress summary reports which are widely distributed at ORNL and other AEC sites. Because of the extent and nature of the distribution, these reports are very brief, summarizing only the pertinent operational information. Necessarily, only limited discussion is presented on such subjects as chemical flowsheet or equipment performance, operational costs, and radiation exposure. Since reporting of such material is necessary for complete coverage of plant operation, a series of operational reports supplementing the monthly progress summary reports will be initiated. This report is the first of this series and covers the period March through May 1954.

2.0 SUMMARY

During the period from March 10 to May 31, 94 dissolvings of Hanford metallurgical waste have been made to recover 18,558 grams of plutonium. Assays of the dissolver solutions, by corrected TTA analysis, indicate a 37 per cent difference between ORNL analysis and Hanford S.F. data.

In general, dissolution of these wastes has been operationally smooth. It has been necessary to modify the liquid return line in the dissolver off-gas to provide sufficient solution refluxing. It has also been necessary to drill out the off-gas condenser tubes to remove siliceous solids. Visual inspection of the 347 SS dissolver vessel has shown slight corrosion effects, the only failure being on the weld of a thermowell during dissolving number H-74.

Lengthening the extraction section from 14 to 18 feet and increasing the pulse amplitude from 0.6 to 1.0 inch has increased the efficiency of the 1A column.

An extraction column upset and leakage of sand from the sand filter necessitated cleaning the plutonium resin column wiper blades during April and May.

Isolation of the americium product has given considerable difficulty. The maximum on-stream life of the americium resin column has been 6 days. Increasing the scrubbing efficiency of the IIA column by varying flowsheet conditions and increasing scrub stage height has failed to bring about relief from excessive americium breakthrough.

Performance of the Lapp Pulsafeeder pumps has been satisfactory with only minor operational difficulties. There have been 2 Chempump, canned-rotor type, pumps burned out due to maloperation during the program.

Pulse column operation has been mechanically smooth for the major part of the program. Both the Lapp and piston-type pulse generators have given little or no difficulty.

Foxboro instrumentation and control of process variables were satisfactory after the elimination of the surging supply air.

Considerable difficulty has been encountered during the program with occasional air contamination of greater-than masking tolerance. The adding a 1-inch off-gas equalizer line and water-tracing the jet line from the dissolver to the hot feed tanks have decreased the air contamination during the jetting operation. The filter medium on the off-gas and air conditioning units has been replaced in an effort to eliminate air contamination in operating areas.

3.0 OPERATIONAL ANALYSIS

Processing of Hanford crucible scrap and waste material for the recovery of plutonium and americium began on March 10, 1954. The chemical and equipment flowsheets being used in this program are presented in the Appendix, Figures 1 and 2, and were described in detail in the March progress report (CF-54-4-223). Presented below is a discussion of the performance of each phase of the chemical flowsheet for the period March through May, 1954.

3.1 Feed Preparation

Detailed data obtained in the dissolutions made to date are presented in the Appendix, Table 8.0-1.

The Hanford waste material consists of MgO crucible fragments, casting fragements, packing sand and metallurgical slag obtained from the reduction operation. Each crucible contains approximately 10 grams of plutonium, which has an irradiation level ranging from 200 to 600 mwd/ton. The crucibles were obtained from reduction batches performed during July 1949 to December 1953 1953. The reduction fragments are of two types: thin walled crucibles weighing approximately 770 grams and heavy crucibles weighing 1,700 grams. The fluoride content of the crucibles varies from 120 to 240 grams each and aids the dissolution procedure. There is no fluoride in the casting fragments. The dissolution of the casting fragments was effected by preparing dissolver batches of casting and crucible fragments together. The controlled fluoride dissolution method described in ORNL-1442 is used. This procedure consists of: (1) partial fluoride complexing combined with iodine removal; (2) dissolution with nitric acid; and (3) complete fluoride complexing and silica digestion.

3.11 Iodine Removal

The iodine removal step in the dissolution procedure has been satisfactory as indicated by the analysis of the dissolver solutions for residual iodate (ranging from 0.138 mg/ml to 1.55 mg/ml with an average of 0.397 mg/ml.) During the iodine removal step it has been necessary to evaporate approximately 18 gallons of feed solution for efficient iodine removal. The volatile gases are removed from the dissolver off-gas with 5 M NaOH in an off gas scrubber.

3.12 Dissolution

After sufficient nitric acid has been added to the dissolver, an additional 15 to 20 gallons of the dissolver liquor is evaporated off to assure complete iodine removal. Some difficulty was encountered during the initial refluxing operation at this point. Frequently, the dissolver pressurized; this was remedied by the addition of a 3-inch liquid return line. The off-gas condenser plugged during dissolving H-64, and cleaning of the siliceous material from the tubes was necessary. Analysis of the solids removed from the off-gas condenser indicated 98 per cent SiO_2.

Only two instances of incomplete dissolution has been observed during the 94 dissolvings performed to date. A heel dissolving performed on batch H-6 yielded only 3.2 grams of plutonium.

The quantity of concentrated (13.6 M) nitric acid added during the dissolution step has been decreased 14 per cent from flowsheet value to obtain a final 6 M free nitric acid concentration.

3.13 Fluoride Complexing and Silica Digestion

This step in the dissolution procedure has given little operational difficulty. Visual inspection of the 347 SS dissolver after each dissolution has indicated only slight corrosion effects; however, during dissolving H-74, a weld on the bottom of a thermocouple well began to leak, and the thermowell was replaced.

The plutonium contained on the residual dissolver solids has ranged from 0.01 to 5.48 per cent (with an average of 0.24 per cent) of the total plutonium in the dissolver solution. A tabulation of these results is found in the Appendix, Table 8.0-1.

3.2 Plutonium Cycle

3.21 Solvent Extraction

Operation of the plutonium solvent extraction cycle has been satisfactory. Flowing stream and composite losses have been 0.14 and 0.21 per cent, respectively. The following flowsheet modifications were made to confine these losses in this range:

(a) The IB column strip stream was increased 15 per cent greater than the flowsheet rate.

(b) The extraction section of the 1A column was increased from 14 to 18 feet to improve extraction efficiency.

(c) The 1A column pulse amplitude was increased from 0.6 inch to 1.0 inch.

Flow rates used in the solvent extraction cycle are presented in Figure No. 1, Appendix.

3.22 Isolation

The plutonium product stream (IBP), 0.25 M in nitric acid and having a plutonium concentration of approximately 0.7 grams per liter, is isolated on a 7-inch diameter resin column packed with Dowex 50 resin. The plutonium is eluted with 9.0 liters of cold (15°C) 5.8 M HNO_3 and 0.25 M sulphamic acid.

3.3 Americium Cycle

3.31 Isolation

The maximum on-stream life of the americium resin columns has been six days. The maximum quantity of americium product sorbed on the resin column before breakthrough has been 0.6 grams. Shortly after a new resin column has been put on stream, a 1 inch brown band is formed. This band moves down at a rate of approximately 4 in. per day until it drops from the column; at this time the americium product begins to break through. In an effort to increase the scrubbing efficiency of the IIA column, the following modifications were made:

(a) Increasing the IIAS rate from 4 to 8 gph;

(b) Using condensate water as IIA column scrub in place of 3 M NH_4NO_3;

(c) Using C.P. NH_4NO_3; and

(d) Increasing the scrub stage height from 17 to 20 feet

At the present time the Chemical Development Section is investigating this problem.

4.0 PLUTONIUM MATERIAL BALANCES

4.1 Over-all Balance

The over-all plutonium balance for the program to date is 98.0 per cent. Of the 18.56 kgs of plutonium inventoried into the dissolver, 15.9 kgs of plutonium have been shipped to the Rocky Flats site for subsequent processing.

4.2 Plutonium Content of Hanford Waste Material

The plutonium content of the dissolver solutions has averaged 63.0 per cent of the calculated quantity of plutonium received from Hanford. An average of 0.24 per cent of the plutonium was retained on the solids after dissolution. Visual inspection of the dissolver after each dissolution indicated the presence of an appreciable heel in only two instances. A heel dissolving was performed on H-6 and yielded only 3.2 grams of plutonium.

An investigation was initiated to compare the magnesium - calcium balance with the plutonium balance. No correlation could be obtained. A tabulation of the results is given in Table 4.2-1.

Table 4.2-1

Comparison of Mg-Ca Balance with Plutonium Balance

Dissolving No.	Actual Mg-Ca (mg/ml)	Hanford Estimation of Mg-Ca (mg/ml)	Actual Pu(TTA) (gms)	Estimated Pu(gms)	Mg-Ca Ratio (actual/ estimated)	Pu Ratio (actual/ (estimated)
H-14	24.3	31.3	128.28	277.59	0.78	0.46
H-17	25.1	36.3	174.13	289.64	0.69	0.60
H-18	23.2	34.8	96.64	255.36	0.67	0.38
H-23	21.7	38.6	112.08	257.60	0.56	0.44
H-25	25.1	33.0	239.57	228.54	0.76	1.05
H-27	28.1	34.2	169.90	240.84	0.82	0.71
H-29	23.6	34.3	121.15	259.36	0.69	0.47
H-30	22.8	32.6	213.92	222.40	0.70	0.96
H-34	22.6	34.1	200.05	241.43	0.66	0.83
H-35	23.9	30.9	178.02	200.03	0.77	0.89
H-37	20.0	20.7	198.62	442.09	0.97	0.44

4.21 Plutonium Content of Solids Leaving Process

The plutonium content of the residual dissolver solids has averaged 0.24 per cent. The heavy solids are removed in settling and disposal pots located on the feed tanks. After approximately five volume changes have been made in the feed tank, the solids are stream-pressured to waste. The plutonium loss from this operation has been less than 0.001 per cent.

Any entrained solid material that is transferred to the extraction columns eventually leaves the process in the IIAW stream. Analysis of the plutonium on the solids in the IAW stream before ammonia neutralization has indicated that 0.19 per cent of the plutonium in the feed is lost on solids in the IAW stream.

5.0 EQUIPMENT PERFORMANCE

5.1 Fluid Flow

5.11 Pumps

(1) Lapp Pulsafeeder Pumps - Eleven Lapp pumps are in service in the Metal Recovery plant. Performance of these piston-diaphragm pumps has been satisfactory. Some of the minor operational difficulties remedied were:

(a) Sticking of the cone-type check valves (recommended for clear liquid) in the CPS-2 feed pump. The siliceous material present in the feed caused erratic delivery. An alternate CPS-2 feed pump has been installed using the recommended flow-through reagent head and ball-type check valves;

(b) Leaks in the hydraulic lines to the reagent head of 6 of the Lapp pumps in service, necessitating frequent air bleeding. This condition has been remedied by back-welding all screwed connections;

(c) Unbalanced compensator valves, accounting for the low capacity of new pumps. In one instance the pressure compensator valve was replaced in a Model CPS-2 pump;

(d) Excessive corrosion of the valve head tie-bar and bolts of pumps used for nitric acid service, necessitating replacement of these parts;

(e) Replacing the fluorothene diaphragm in use on the CPS-2 feed pump, in service for a period of approximately two years. The diaphragm was replaced shortly after the initial start up of the program. Close inspection of the replaced diaphragm revealed several small ruptures that had not completely penetrated the diaphragm.

(f) Improper motor alignment, causing an over-heated condition in one CPS-1 unit; and

(g) Replacing a universal joint and stroke proportionator arm on a CPS-2 pump in the early part of April.

(2) Milton Roy Pumps

Milton Roy pumps are used to pump non-radioactive aqueous streams and radioactive solvent. The performance of these pumps has been satisfactory. Some air locking of the ball checks has been experienced, but has not been excessive. The grease seal reduction housing on a Model 2-518-74-S duplex unit was replaced.

(3) Chempumps

Performance of the canned-rotor type pump has been satisfactory in clear liquid service. The maintenance-free features of the Chempump gives it a definite advantage over the conventional centrifugal pumps. Two major difficulties have been encountered during the past three months, these can be attributed to maloperation. In one instance the suction and discharge valves of a Model CF-1/3 pump were closed. The pump ran hot for a period of approximately 5 hours causing the bearing assembly and rota-shaft to become scored. After a failure of a similar type pump, used in solvent recirculation service, disassembly of the unit indicated holes through the canned-rota and stator assembly. This is believed to have been caused by an inefficient seal or leakage of solvent through the stator sub-assembly. The electrical housing or stator sub-assembly of this type pump is the most vunerable part of the pump. Painting the extremities of the pump with Glyptal has helped to water-proof the stator sub-assembly.

The seal-less centrifugal Chempump is a new type of unit at ORNL and local maintenance has been unsatisfactory.

(4) Centrifugal Pumps

Only one Eastern centrifugal pump is in radioactive service in the plant. This pump, used to transfer solvent to the solvent wash column, has performed satisfactorily.

5.12 Jets

The duPont jet (maximum 50 gal/min) used for solution transfer from the dissolver to the feed tanks has plugged occasionally. Insertion of a blank teflon gasket having 1/8-inch perforating on the suction side of the jet has eliminated throat plugging and decreased the quantity of solids transferred to the feed tanks.

5.13 Valves

Two failures of the Mason-Neilan (Arco) enclosed air valves have taken place during the Metal Recovery program. In each case the stem was broken off - caused by a sudden release of air from the valve housing, allowing the return spring to snap back suddenly. Installation of orifice fittings on the air switches has eliminated the rapid return of the valve stem.

5.2 Solvent Extraction

5.21 Pulse Columns

Pulse column operation has been mechanically smooth on the plutonium cycle. One major column upset has been encountered. The IAW line to the continuous neutralizer became plugged; this caused an excess quantity of solvent to overflow the IB column and contaminate the plutonium resin column system.

Column data for the Metal Recovery columns are presented in Table 5.21-1.

Table 5.21-1

Column Data

Column	Diameter (in.)	Pulse Amplitude (in.)	Pulse Frequency (cycles/min)	Pulser (type)
1A	4	1.00	60	CPS-4 Lap
1B	2-1/2	1.00	52	CPS-2 Lap
IIA	6-5/8	1.25	50	Piston
IIB	6-5/8	0.95	50	Piston
Solvent	8	1.00	50	Piston
Solvent Wash	5-1/2	-	-	None

5.22 Pulse Generators

Two types of pulse generators are currently in use at the Metal Recovery building. The IA and IB columns utilize Lapp Pulsafeeder pumps as pulse generators, and the 6-5/8-inch americium columns and the solvent column use ORNL designed piston-type pulsers driven by 1 HP Varidrive motors. Leakage from the piston-type pulse generators has been satisfactory, as indicated by the following leakage rates:

Column	Leakage (cc/min)
IIA	6
IIB	36
Solvent	24

5.3 Ion Exchange

5.31 Plutonium

Sorption and elution of the plutonium product on the Dowex 50 resin have been satisfactory. The major column upset discussed in Section 5.21 has caused operational difficulty by the plugging of all 3 resin columns. Inspection of the resin columns revealed an accumulation of sand, glass wool and solvent. Normal operation was resumed after the wiper blades were scrubbed and assembled and the solvent was removed from the system.

5.4 Process Control and Instrumentation

Foxboro instrumentation is used in the Metal Recovery plant for the measurement and control of temperatures, liquid levels and densities. This type of instrumentation has given satisfactory service in the plant for 3 years with no major difficulties.

5.41 Instrument Air Supply

Oil and water are removed from the instrument air supply with two sand-stone filters. After the air supply is passed through the filters, it is directed through an Industrol Dynamic Dehumidifier, which is a dual-chamber adsorptive unit. This unit consists of two chambers, each chamber is packed with Savobead desiccant and contains its own heating unit for reactivation. Incoming air is directed through the first chamber while the desiccant in the second chamber is being reactivated by a 24-hour heating and cooling cycle.

The condition and delivered pressure of the ORNL plant air have fluctuated considerably. Two additional pressure reducing stations have been installed prior to d/p cells to eliminate surges of supply air. The Socony-Vacuum Sovabead desiccant and the sand-stone filters were replaced during February.

5.42 Transmitters

Foxboro differential pressure transmitters, types 3A and 5A, are used in the plant. These transmitters are calibrated with a fixed supply pressure of 20 + 0.5 psi and ranges vary from 0-100 to 0-25 inches of water. The only major d/p cell failure that has occurred was caused by a ruptured bellows on a type 3A cell. Improper, small radius bends on the transmission lines necessitated replacement of small sections of some piping. In some instances, when a tank was being recalibrated, the d/p cell calibrations have shifted slightly (P-6 d/p cell has recently shifted 1%). Prior to the replacement of the desiccant in the dehumidifier (Section 5.41), some cleaning of the flapper-nozzles in the d/p cell became necessary.

5.43 Receivers

Foxboro Multi-Record pneumatic receivers are used for recording process variables. These receivers will record six process variables on one circular chart. After conversion of the process variables in terms of 3-15 pounds pressure by the d/p cell, the signal pressures are directed to a single measuring circuit and a record is printed for each one. The air-switch on one of the units has been replaced because of excessive binding due to improper lubrication. In one instance the chart motor was replaced. This can be attributed also to improper lubrication. One bellows unit had to be replaced.

5.44 Controllers

Model 52 Consotrol controllers are used in the plant. This type of controller is a non-recording, indicating type which requires a supply pressure of 20 psi and has an output range of 3-15 psi under normal operation. In one instance a proportioning bellows was found to be punctured.

5.5 Equipment Modifications

One solids settling and disposal unit has been installed on each of the hot feed tanks. Installation of these units on the suction side of the IAF Lapp feed pumps has increased pumping efficiency. Plutonium losses due to the solids disposal operation have been less than 0.001 per cent.

A Model F Chempump has been installed on the elutriant makeup tank for water circulation service to maintain a solution temperature of 15°C during the elution cycle.

6.0 RADIATION LEVELS

Considerable difficulty has been encountered during the Hanford metallurgical waste program with plutonium air contamination. During the period from March 19 to May 26, 45 instances of air contamination exceeding tolerance level (6×10^{-12} μc Pu/cc air) has taken place in operating areas. The air count on these occasions ranged from 6.1×10^{-12} to 9.9×10^{-9} μcPu/cc air.

An investigation has been initiated to determine the origin of the excess contamination by placing air samplers in various locations during isolated periods of operation. Indications are that a large portion of the excessive air contamination originates during the jetting of the dissolver to the hot feed tanks. Installating an additional one-inch off-gas line to the hot stack area and water-tracing the jet piping has helped to decrease air contamination.

The vessel off-gas is discharged by means of a blower to the roof of Building 3505. Located approximately 10 feet from the off-gas discharge is the air conditioning intake unit. Inspection of the off-gas filter unit indicated that all five of the filter plates, each containing one FY-50 and two FY-100 filters, were damaged badly. The filter plates were repacked with 3 layers of Type 2, FY-50 material. Inspection of the air conditioning filter unit indicated a 24-inch void space between filter plates. The air conditioning unit was repacked with Airmat PL-24, 6 ply treated paper.

All personnel have been instructed to wear the recommended assault-type masks in sampling, in all cells, during the jetting operation and in areas where air contamination is known to exist.

7.0 SAFETY

There have been seven minor injuries sustained by Metal Recovery personnel during the program.

Table 7.0-1

Injuries Sustained During Hanford Waste Program

Name	Injury	
Glasgow, J. M.	Laceration of hand	Broken sample bottle
Lockmiller, J. F.	Burner hand	Checking motor
Thompson, H. C.	Abrasion and contusion of scalp	Improper window projection
Tipton, C. H.	Burned hand	Broken steam lose
Jones, C. H.	Eye	Nitric acid leak on valve
Jones, C. H.	Laceration of scalp	Improper window projection
Spencer, S. E.	Laceration of hand	Broken suction flask

In an effort to minimize the hazards involved in nitric acid handling, individual acid storage tanks have been installed adjoining make up tanks. Nitric acid unloading facilities have been located away from the building.

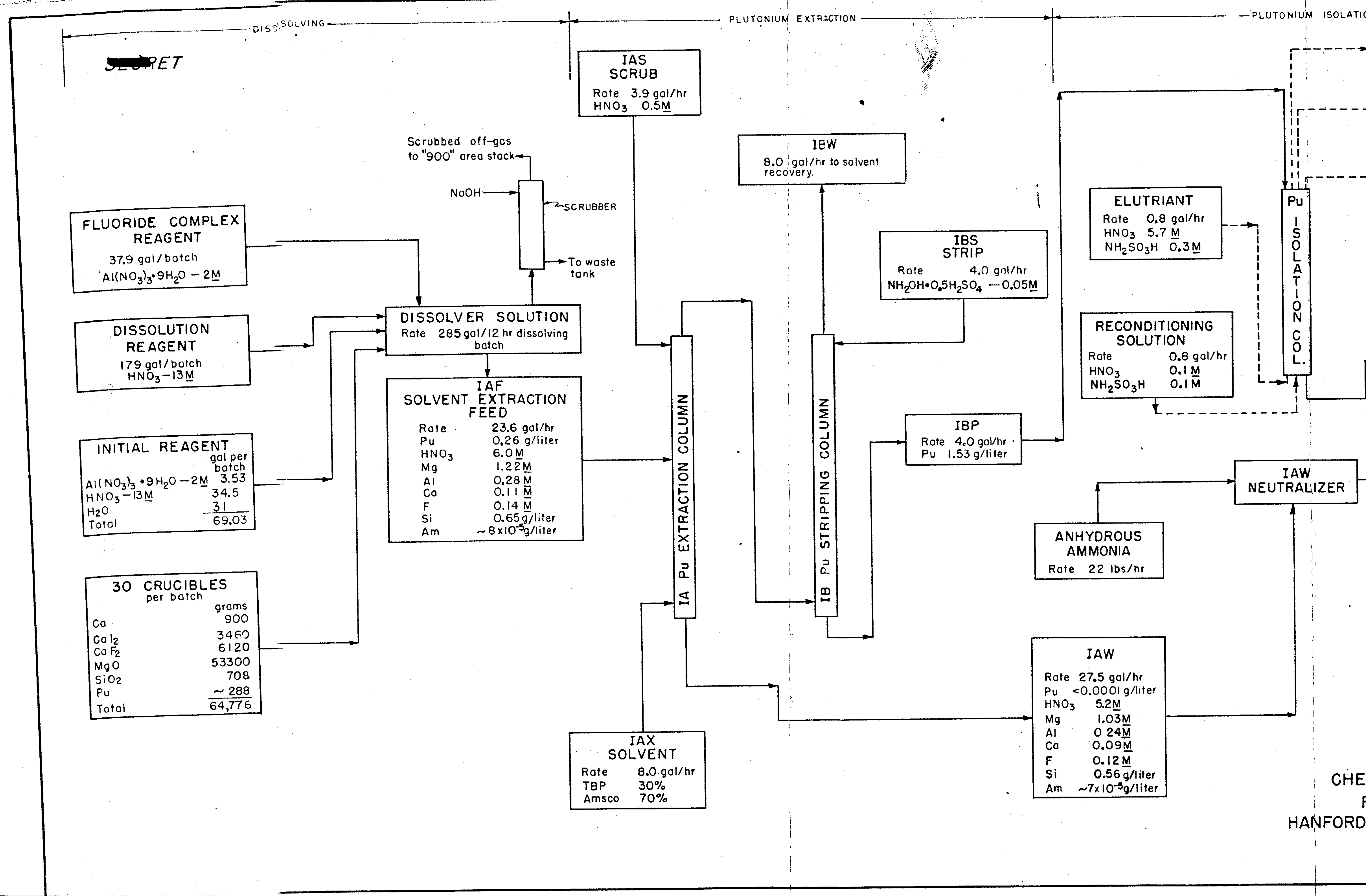
There have been two additional safety showers installed in hazardous areas.

In view of the scalp injuries sustained on the window projections on the north side of the building, window guards have been installed on each unit.

R E Brooksbank
R. E. Brooksbank

8.0 APPENDIX

[redacted]RET



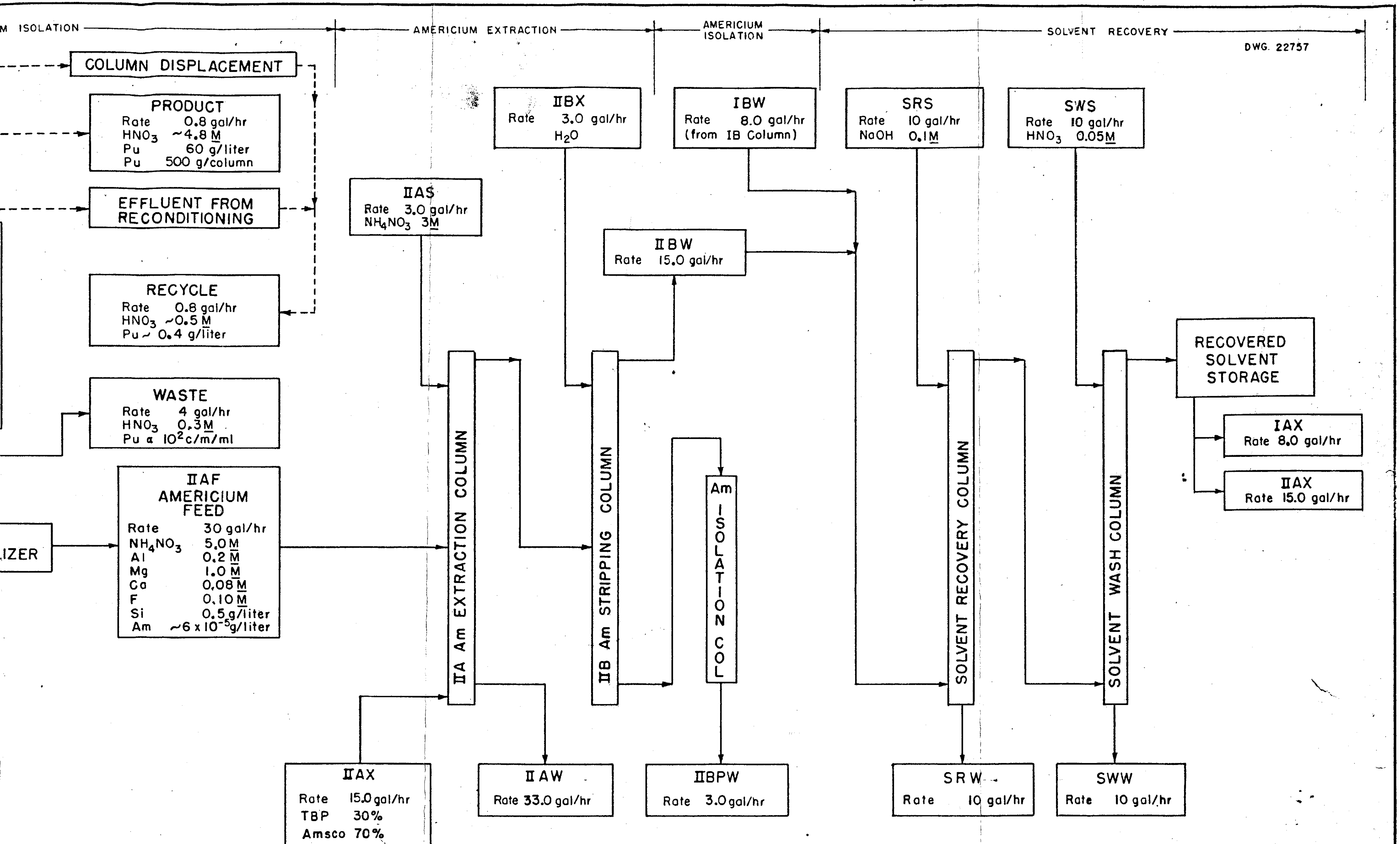
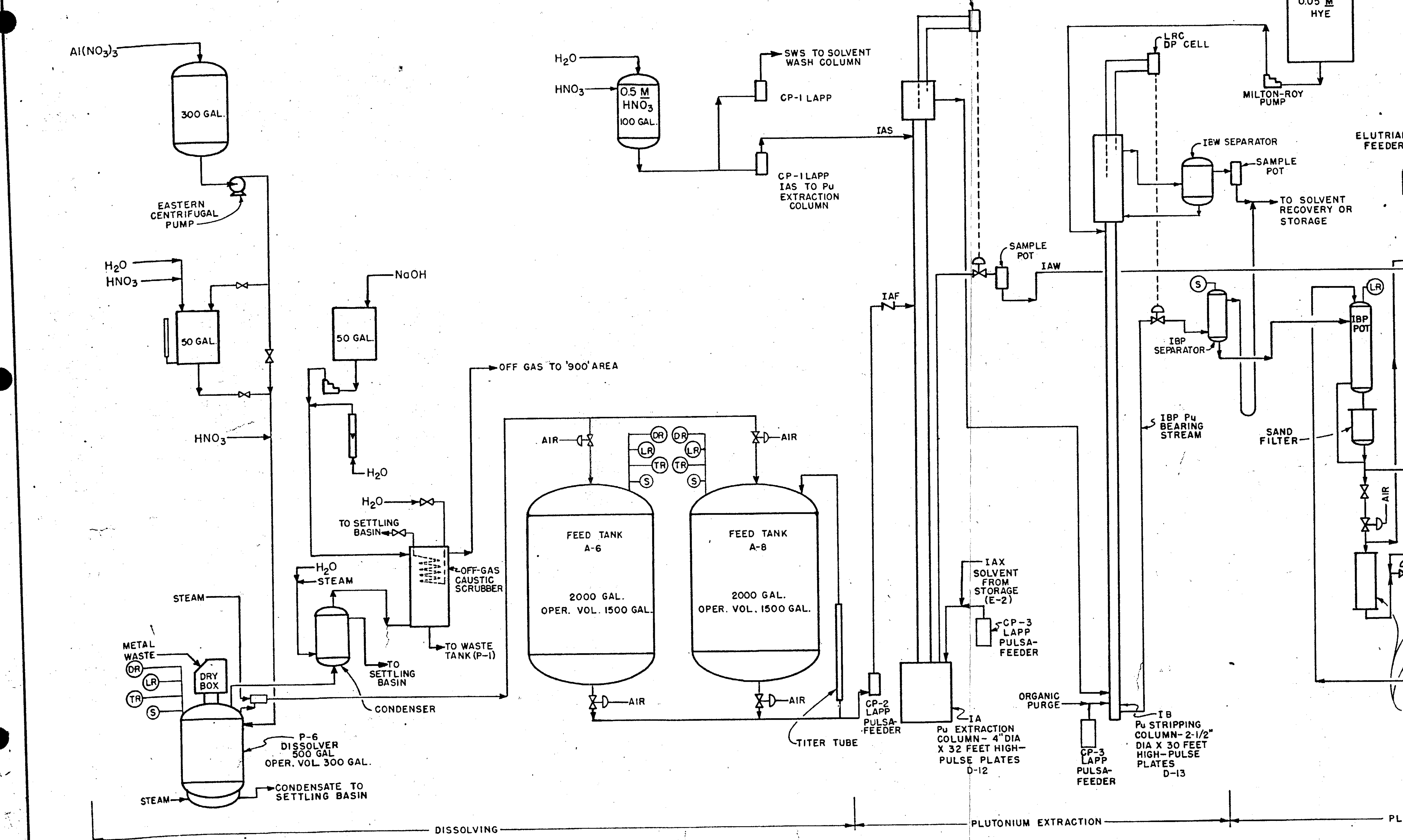


Fig. I
CHEMICAL FLOWSHEET
FOR PROCESSING
NFORD METALLURGICAL WASTE
1-15-54

~~SECRET~~

S[redacted]RET



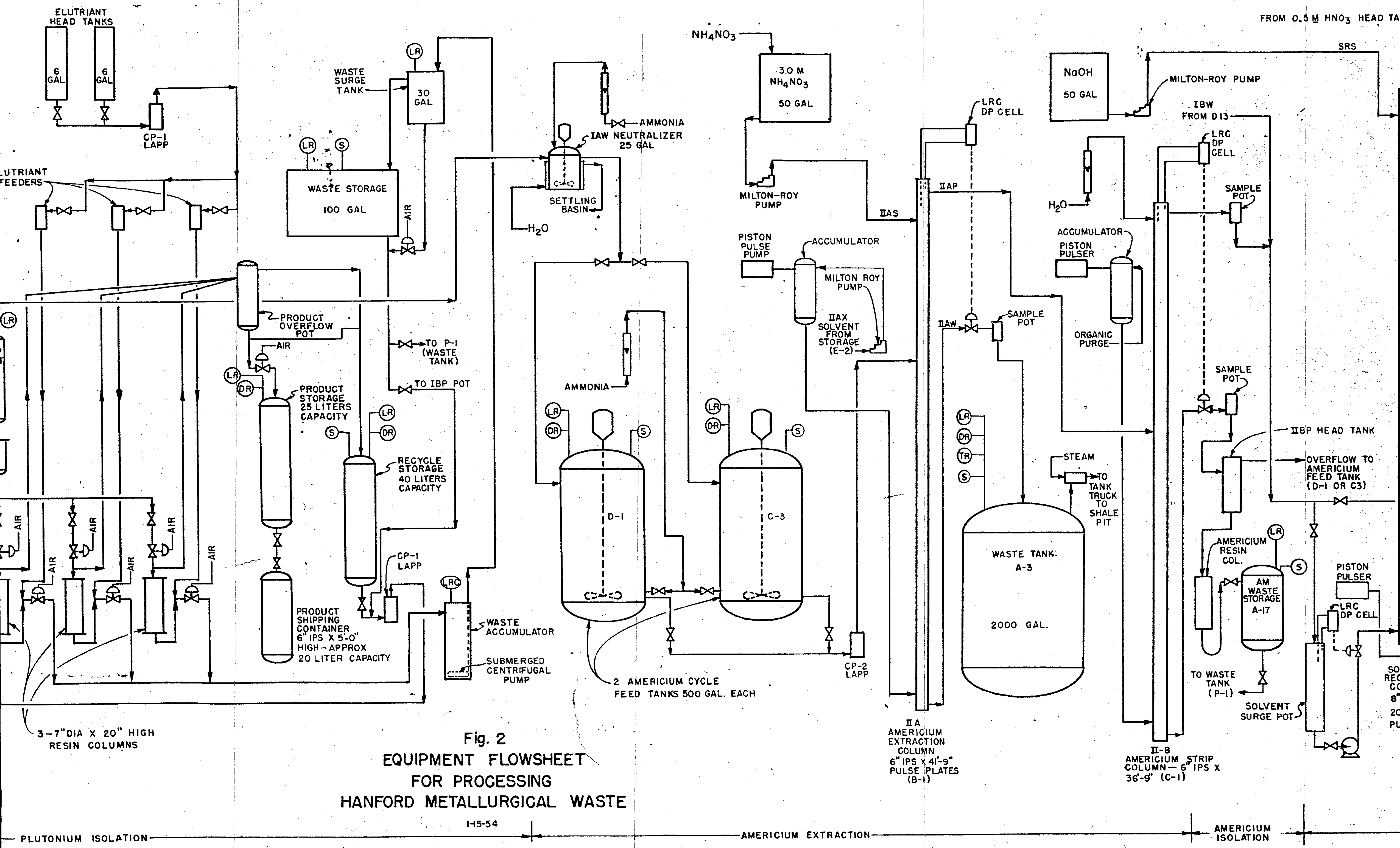
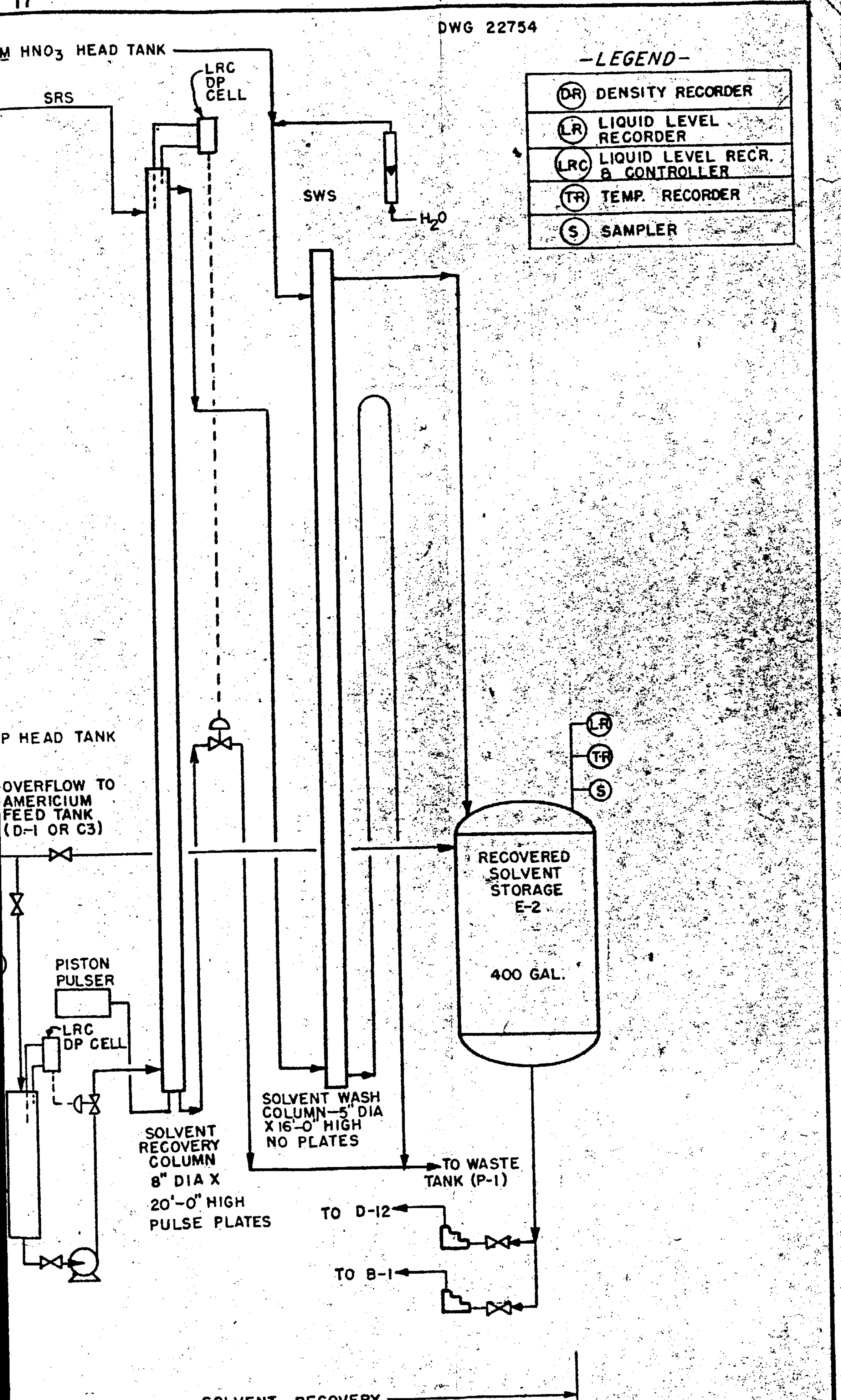


Fig. 2
EQUIPMENT FLOWSHEET
FOR PROCESSING
HANFORD METALLURGICAL WASTE


DWG 22754
M HNO_3 HEAD TANK
SRS
LRC DP CELL
SWS
H_2O
-LEGEND-
DR DENSITY RECORDER
LR LIQUID LEVEL RECORDER
LRC LIQUID LEVEL RECR. & CONTROLLER
TR TEMP. RECORDER
S SAMPLER
P HEAD TANK
OVERFLOW TO AMERICIUM FEED TANK (D-1 OR C3)
PISTON PULSER
LRC DP CELL
LR
TR
S
RECOVERED SOLVENT STORAGE E-2
400 GAL.
SOLVENT RECOVERY COLUMN 8" DIA X 20'-0" HIGH PULSE PLATES
SOLVENT WASH COLUMN-5" DIA X 16'-0" HIGH NO PLATES
TO WASTE TANK (P-1)
TO D-12
TO B-1
SOLVENT RECOVERY

SECRET

[redacted]

Table

Summary of Dissolution V

Dissolution Number	Total Crucibles Charged	Initial Reagent (Gallson) 13M HNO_3	H_2O	ANN	Dissolution Reagent 13 M HNO_3	Fluoride Complex 2 M ANN (Gallons)	Gal	HN
H-1	27Y	35.5	31.0	3.8	160	41.2	278	7
H-2	31Y	27.2	25.1	4.4	184	47.3	294	7
H-3	34Y	29.6	27.3	4.8	202	51.9	319	7
H-4	30Y	26.3	23.7	4.3	178	45.8	244	7
H-5	28	24.6	22.7	4.0	166	42.7	259	6.
H-6	32	23.3	19.7	5.5	190	58.5	391	6.
H-7	30	21.3	17.9	5.2	178	56.1	289	6.
H-8	33	26.2	23.2	5.2	196	55.7	297	7.
H-9	33	28.7	30.6	5.7	180	61.3	303	7.
H-10	28	28.4	31.9	4.0	153	42.7	329	6.

lumes and Concentrations

Final Dissolver Solution								
3 (N)	Sp G	IO_3 (mg/ml)	Pu Loss on Solids (%)	Plutonium Content(a) (gm) ORNL	Plutonium Content (gm) Hanford Estimate	Per Cent (b)	Boxes Charged	Americium Content Estimate
25	1.37	0.430	0.90	79.54	191.51	41.53	RGY 901 904	0.019
4	1.40	-	0.20	143.31	254.52	56.3	RGY 905 902	0.030
07	1.40	0.478	0.10	177.20	285.23	62.1	RGY 903 906	0.029
7	1.37	0.607	0.20	130.23	215.11	60.5	RGY 907 908	0.025
0	1.39	-	0.10	167.76	260.51	64.4	RGY 909 911 912	0.032
4	1.39	0.755	0.10	201.41	270.43	74.5	RGY 910 006	0.051
5	1.39	0.535	0.10	151.86	312.16	48.6	RGY 007 026	0.072
9	1.40	0.903	< 0.10	206.02	316.24	65.2	RGY 033 008	0.076
9	1.37	0.736	0.20	142.68	271.83	52.5	RGY 005 043	0.059
5	1.37	0.204	0.10	107.72	161.78	62.7	RGY 002 040	0.040

Table 8.

Summary of Dissoluti

Dissolution Number[(a)]	Total Crucibles Charged	Initial Reagent (Gallons)			Dissolution Reagent	Fluoride Complex 2 M ANN (Gals)	
		13M HNO_3	H_2O	ANN	13 M HNO_3		Gal
H-11	30 Y	29.2	32.7	4.3	166	45.8	278
H-12	31 Y	22.5	22.4	6.1	172	65.0	285
H-13	31 Y	29.0	32.1	4.7	172	50.2	283
H-14	30 Y	25.5	27.2	5.1	166	54.2	277
H-15	34 Y	28.5	25.8	5.1	202	54.6	305
H-16	27 Y	20.5	17.4	4.7	160	50.4	245
H-17	30 Y	27.0	25.9	4.3	175	45.8	239
H-18	34 Y	28.4	26.5	5.3	199	56.8	282
H-19	32 Y	22.7	19.5	5.8	187	62.0	286
H-20	27 Y	18.5	15.7	5.0	158	53.8	243
H-21	27 Y	24.4	23.5	3.8	158	41.3	238
H-22	31 Y	22.0	46.5	5.6	181	60.5	278
H-23	31 Y	28.2	27.1	4.4	181	47.3	233
H-24	33 Y	29.6	28.3	4.7	193	55.1	288
H-25	31 Y	25.2	23.1	5.0	181	53.7	272
H-26	33 Y	29.6	28.3	4.7	193	50.4	297
H-27	28 Y	24.9	21.9	4.2	164	45.0	237
H-28	31 Y	23.9	21.3	5.3	181	56.5	256
H-29	32 Y	28.1	26.6	4.7	187	50.6	270
H-30	30 Y	27.0	25.9	4.3	175	45.8	266
H-31	51 Y	28.2	27.1	4.4	181	47.3	268
H-32	25 Y	22.6	21.7	3.6	146	38.1	221
H-33	29 Y	26.3	25.3	4.1	169	44.3	263
H-34	30 Y	27.0	25.9	4.3	175	45.8	254
H-35	34 Y	23.7	21.6	4.8	174	51.9	279

)-1 (continued)

on Volumes and Concentrations

Final Dissolver Solution				Plutonium Content (gm)(b) ORNL	Plutonium Content (gm) Hanford Estimate	Per Cent(c)	Boxes Charged	Americium Content Estimate
HNO_3 M	Sp G	IO_3 (m/ml)	Pu Loss on Solids (%)					
6.39	1.38	0.605	0.50	152.89	233.26	65.5	RGY - 025 032	0.058
6.44	1.39	0.461	0.37	192.78	336.14	57.4	" - 029 035	0.076
6.13	1.38	0.915	0.03	339.86	253.46	134.1	" - 001 037	0.064
6.39	1.39	0.326	0.03	128.28	277.59	46.2	" - 021 034	0.069
6.64	1.39	0.336	0.32	175.41	308.17	56.9	" - 003 024	0.077
6.89	1.41	0.672	0.02	173.51	327.30	53.0	" - 009 020	0.078
5.87	1.40	0.355	0.12	174.13	289.64	60.1	" - 015 022	0.072
6.41	1.40	0.176	5.48	96.64	255.36	37.8	" - 018 031	0.063
6.61	1.40	0.660	0.09	226.81	340.32	66.7	" - 023 027	0.079
7.50	1.39	0.481	0.01	193.43	313.18	61.8	" - 038 042	0.070
7.37	1.40	0.787	0.01	163.39	296.42	55.1	" - 044 047	0.065
7.27	1.40	0.379	0.14	150.68	275.89	54.6	" - 016 028	0.065
6.18	1.41	0.378	0.23	112.08	257.60	43.5	" - 010 019	0.061
.68	1.39	0.236	0.25	118.60	238.92	49.6	" - 004 046	0.056
.09	1.40	0.337	0.19	239.57	228.54	104.8	" - 014 048	0.055
.28	1.40	0.309	0.06	124.01	190.06	65.3	" - 011 013	0.051
.68	1.42	0.393	0.02	169.90	240.84	70.5	" - 012 036	0.061
.78	1.40	0.350	0.02	132.19	192.80	68.6	" - 017 039	0.050
.38	1.40	0.238	0.12	121.15	259.36	46.7	" - 049 418	0.058
.98	1.40	0.641	0.03	213.92	222.40	96.2	" - 116 111	0.043
74	1.40	0.201	0.09	144.48	238.38	60.6	" - 113 114	0.061
13	1.40	0.442	0.01	155.94	188.01	82.9	" - 136 163	0.039
11	1.39	0.485	0.02	158.53	222.11	71.4	" - 137 151	0.050
83	1.40	0.350	0.05	200.05	241.43	82.9	" - 122 133	0.045
78	1.39	0.296	0.01	178.02	200.03	89.0	" - 150 167	0.059

Table 8.0-

[redacted]

Summary of Dissolution

Dissolution Number[a]	Total Crucibles Charged	Initial Reagent (Gallons) 13M HNO_3	H_2O	ANN	Dissolution Reagent 13 M HNO_3	Fluoride Complex 2 M ANN (Gals)	Gal
H-36	34 Y	30.8	29.9	4.8	199	51.9	297
H-37	35 Y	33.8	32.8	5.0	213	53.4	321
H-38	23 X	21.2	20.4	3.3	134	35.1	214
H-39	26 X	23.3	22.3	3.7	152	39.7	272
H-40	20 X	22.4	22.2	2.8	133	30.6	212
H-41	18 Y	21.5	21.5	2.6	124	27.6	183
H-42	29	18.2	16.2	4.1	140	43.5	234
H-43	40 Y	21.5	21.5	2.6	171	61.0	255
H-44	39 Y	18.2	16.2	4.1	157	59.6	245
H-45	33 Y	18.4	18.4	5.7	173	50.4	236
H-46	51 Y	15.3	11.6	5.5	176	77.8	323
H-47	66 Y	23.9	22.0	4.7	193	100.6	329
H-48	28 Y	23.8	19.3	7.3	164	42.7	236
H-49	27 Y	18.9	11.7	9.4	158	41.3	259
H-50	30 Y	25.2	24.1	4.0	175	45.8	293
H-51	14Y + 15Z	37.6	40.0	2.0	172	21.4	252
H-52	16Y + 63Z	39.5	41.8	2.3	182	24.4	277
H-53	18Y + 63Z	39.5	41.5	2.6	187	27.4	264
H-54	14Y + 56Z	38.1	40.5	2.0	173	21.4	251
H-55	17Y + 33Z	28.3	29.3	2.4	146	26.0	210
H-56	26	23.3	22.0	3.7	152	39.3	221
H-57	15Y + 40Z	27.9	29.1	2.1	140	22.9	217
H-58	20Y + 14Z	23.3	23.3	2.8	140	30.6	247
H-59	12Y + 75Z	40.0	43.0	1.7	176	18.3	274
H-60	13Y + 56Z	33.6	35.7	1.9	155	21.9	232

1 (continued)

Volumes and Concentrations

Final Dissolver Solution				Plutonium Content (gm)(b) ORNL	Plutonium Content (gm) Hanford Estimate	Per Cent(c)	Boxes Charged	Americium Content Estimate
NO_3 M	Sp G	IO_3 (mg/ml)	Pu Loss on Solids (%)					
7.35	1.40	0.306	0.01	305.76	413.35	74.0	RGY - 131, 177	0.111
8.03	1.39	0.327	0.05	198.62	442.09	44.9	" - 157, 166	0.140
7.07	1.38	0.409	0.09	369.31	473.45	78.0	RMX - 361	0.056
7.63	1.38	0.328	0.05	337.68	367.67	91.1	RMX - 324	0.056
.08	1.39	0.627	0.02	342.13	456.10	75.0	RMX - 327	0.069
.31	1.39	0.379	0.09	338.61	414.33	81.7	RGY - 117	0.151
.14	1.40	0.291	0.02	349.91	304.18	115.0	RGY - 101, 126	0.085
.12	1.42	0.699	0.01	221.09	260.55	84.9	RGY - 162, 130	0.091
.27	1.42	0.605	0.05	336.77	418.21	80.5	" - 182, 103	0.129
.15	1.41	0.437	0.10	209.65	232.67	90.1	" - 158, 145	0.053
.93	1.39	0.597	0.01	293.33	475.12	61.7	" - 143, 168	0.167
.01	1.39	1.150	0.01	276.49	377.16	73.3	" - 181, 184	0.130
.27	1.40	0.423	0.01	149.40	192.36	77.7	" - 149, 105	0.037
.46	1.37	0.416	0.01	149.05	201.75	73.9	" - 148, 138	0.047
.07	1.38	0.445	0.01	205.21	232.63	88.2	" - 129, 156	0.077
.24	1.37	0.416	0.07	106.40	201.27	52.9	RGY - 187, RGZ - 041	0.026
.84	1.40	0.832	0.11	280.00	247.25	113.2	RGY - 139, RGZ - 045	0.026
.79	1.40	0.212	0.12	240.22	289.16	83.1	RGY - 170, RGZ - 098	0.030
.02	1.39	0.241	0.12	201.84	252.74	79.9	RGY - 104, RGZ - 096	0.025
.90	1.41	0.277	0.08	183.07	229.52	79.7	RGY - 123, RGZ - 050	0.033
07	1.40	0.292	0.03	395.66	174.06	227.3	RGY - 174, RGY - 183	0.065
93	1.39	0.277	0.01	221.44	249.23	88.8	RGY - 102, RGZ - 099	0.032
50	1.38	0.270	0.02	139.31	206.13	67.6	RGY - 171, RMZ - 323	0.040
04	1.39	0.160	1.41	185.93	270.44	68.8	RGY - 152, RGZ - 198	0.014
71	1.40	0.240	0.07	164.07	220.89	74.3	RGY - 124, RGZ - 095	0.017

-20-

Summary of Dissolution V

Dissolution Number[a]	Total Crucibles Charged	Initial Reagent (Gallons)			Dissolution Reagent	Fluoride Complex 2 M ANN (Gals)	F	
		13M HNO_3	H_2O	ANN	13 M HNO_3		Gal	HNO_3
H-61	26 Y	23.3	23.3	3.7	152	39.7	224	7.
H-62	9Y + 93Z	44.6	48.4	1.3	184	13.7	275	8.
H-63	11Y + 52Z	30.3	32.3	1.6	138	16.3	217	7.
H-64	15Y + 81Z	42.6	45.4	2.1	193	23.9	279	8.
H-65	16Y + 45Z	36.7	38.6	2.3	135	24.4	226	6.
H-66	14Y + 83Z	45.2	48.4	2.0	171	21.4	255	7.
H-67	16Y + 76Z	41.9	44.4	2.3	166	24.4	250	7.
H-68	23Y + 65Z	33.5	35.1	3.3	155	35.1	249	6.
H-69	10Y + 52Z	27.7	29.6	1.4	108	15.3	171	7.
H-70	15Y + 81Z	45.4	48.6	2.1	174	22.9	289	7.
H-71	17Y + 73Z	37.8	39.8	2.4	156	26.0	236	7.
H-72	20Y + 76Z	36.2	37.4	2.8	157	30.6	245	7.
H-73	13Y + 66Z	37.4	39.9	1.8	145	19.9	225	7.
H-74	14Y + 69Z	37.6	40.0	2.0	148	21.4	236	6.
H-75	16Y + 36Z	27.2	28.1	2.3	121	24.4	196	7.
H-76	9Y + 58Z	30.9	33.1	1.3	115	13.7	197	7.
H-77	16Y + 59Z	35.7	37.6	2.3	147	24.4	234	7
H-78	21Y + 64Z	42.5	44.5	3.0	155	32.0	261	5
H-79	26Y + 40Z	37.9	38.7	3.7	153	39.7	254	6
H-80	26Y + 70Z	48.8	50.8	3.7	193	43.7	309	6
H-81	27Y + 41Z	39.5	40.4	3.8	158	41.3	257	5
H-82	23Y + 72Z	47.2	49.4	3.3	171	35.1	263	6
H-83	26Y + 77Z	51.2	53.4	3.7	190	39.7	315	6
H-84	34Y + 41Z	46.8	47.5	4.8	192	51.9	316	6
H-85	22Y + 64Z	38.9	42.4	3.1	148	33.6	238	6

(continued)

olumes and Concentrations

inal Dissolver Solution				Plutonium Content (gm)(b) ORNL	Plutonium Content (gm) Hanford Estimate	Per Cent (c)	Boxes Charged	Americium Content Estimate
M	Sp G	IO_2 (mg/ml)	Pu Loss on Solids (%)					
1	1.41	0.415	0.02	223.78	383.96	58.3	RGY - 180 155	0.124
7	1.37	0.138	0.58	170.44	307.33	55.5	RGY - 120 RGZ - 172	0.015
4	1.39	0.189	0.02	173.71	259.27	67.0	RGY - 134 RGZ - 160	0.016
6	1.39	0.197	0.23	143.64	416.49	34.5	RGY - 106 RMZ - 335	0.069
1	1.39	0.270	0.37	185.21	242.62	76.3	RGY - 107 RGZ - 197	0.023
2	1.38	0.168	0.15	171.37	344.84	49.7	RGY - 127 RGZ - 159	0.027
7	1.39	0.182	0.11	109.81	448.31	24.5	RGY - 188 RMZ - 368	0.026
2	1.39	0.241	0.21	142.01	230.64	61.6	RGY - 176 RMZ - 303	0.048
4	1.40	0.277	0.04	63.89	303.90	21.0	RGY - 119 RGZ - 209	0.016
3	1.39	0.234	0.01	203.41	376.79	54.0	RGY - 175 RGZ - 199	0.026
6	1.38	0.226	0.42	283.83	406.32	69.9	RGY - 190 RGZ - 192	0.042
4	1.39	0.423	0.33	154.50	299.24	51.6	RGY - 186 RMZ - 391	0.034
1	1.39	0.248	0.12	279.60	429.04	65.2	RGY - 147 RGZ - 191	0.043
8	1.40	0.241	0.59	160.37	283.02	56.7	RGY - 140 RGZ - 206	0.017
1	1.38	0.248	0.52	95.29	210.70	45.2	RGY - 169 RMZ - 202	0.026
7	1.39	0.226	0.89	144.57	218.31	66.3	RGY - 154 RGZ - 196	0.012
6	1.39	0.233	0.28	174.50	425.02	41.1	RGY - 112 RMZ - 377	0.023
8	1.40	0.291	0.71	175.33	368.92	47.5	RGY - 144,030 RMG - 201	0.042
5	1.40	0.321	0.02	167.29	346.33	48.3	RGY - 142,173 RMZ - 395	0.039
9	1.39	0.299	0.02	185.83	464.17	40.0	RGY - 110,179 RMZ - 344	0.061
6	1.41	0.294	0.04	231.20	398.09	58.1	RGY - 165,125 RMZ - 383	0.059
3	1.40	0.372	0.01	199.00	430.42	46.2	RGY - 128,108 RMZ - 399D	0.121
9	1.39	0.284	0.07	248.47	465.72	53.4	RGY - 115,185 RGZ - 204	0.081
6	1.39	0.204	0.74	224.04	353.09	64.3	RGY - 141,164 RGZ - 183	0.052
3	1.38	0.219	0.05	170.05	460.72	36.9	RGY - 169 RMZ - 354	0.069

SEC[redacted]

Summary of Dissolution

Dissolution Number (a)	Total Crucibles Charged	Initial Reagent (Gallons)			Dissolution Reagent	Fluoride Complex		
		13M HNO_3	H_2O	ANN	13 M HNO_3	2 M ANN (Gals)	Gal	HN
H-86	31Y + 102Z	50.5	51.9	4.4	196	47.3	326	6
H-87	16Y + 81Z	44.2	47.1	2.3	149	24.4	231	6
H-88	29Y + 56Z	46.0	47.2	4.1	182	44.7	319	6
H-89	34Y + 44Z	46.8	47.5	4.8	192	51.9	306	6
H-90	46Y + 51Z	37.2	35.0	6.5	191	70.3	304	6
H-91	54Y + 55Z	32.9	29.0	7.7	193	82.4	337	5
H-92	13X+29Y+60Z	40.1	38.8	6.0	191	64.1	381	7
H-93	54 Y	23.0	17.9	7.7	167	82.4	277	5
H-94	19X + 27Y	20.0	15.8	6.5	143	69.7	251	5

(a) Dissolvings H-11 through H-50 were made during April
(b) Count analysis.
(c) Rati

1 (continued)

Volumes and Concentrations

Final Dissolver Solution				Plutonium Content (gm)(b) ORNL	Plutonium Content (gm) Hanford Estimate	Per Cent (c)	Boxes Charged	Americium Content Estimate
O_3 M	Sp G	IO_3 (mg/ml)	Pu Loss on Solids (%)					
.99	1.39	0.233	0.07	172.93	434.46	39.8	RGY - 161 RMZ - 322,203	0.070
.67	1.40	0.189	0.10	135.88	474.27	28.7	RGY - 153 RGZ - 207	0.020
.38	1.38	0.307	0.04	192.16	472.00	40.7	RGY - 121,146 RGZ - 208	0.046
.27	1.41	0.358	0.32	223.25	454.96	49.1	RGY - 109,135 178 - RMZ-200	0.087
.37	1.40	0.394	0.30	206.15	433.56	47.5	RGY - 132,227 RMZ - 205	0.090
.94	1.39	0.554	0.04	311.95	450.53	69.2	RGY - 221,222 RMZ - 313	0.092
.66	1.41	0.527	1.38	325.96	462.00	70.6	RGY - 200,226 RGZ - 212	0.091
.65	1.39	0.642	0.65	340.31	436.30	78.0	RMZ - 216 RGY - 285	0.093
.50	1.41	0.774	0.04	345.88	397.59	87.0	RGY - 243 RMZ - 262	0.113

of plutonium dissolver analysis and Hanford SF data

[redacted]